MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2020/2021

ETN3056 - COMMUNICATIONS NETWORKS

TE

XX OCTOBER 2020
XX:00 PM – XX:00 PM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages (including this cover page) with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

A link-state routing algorithm is vital in a packet-switched network. Fig. Q1 depicts a graph of packet-switched network that consists of routers u, v, w, x, y, and z.

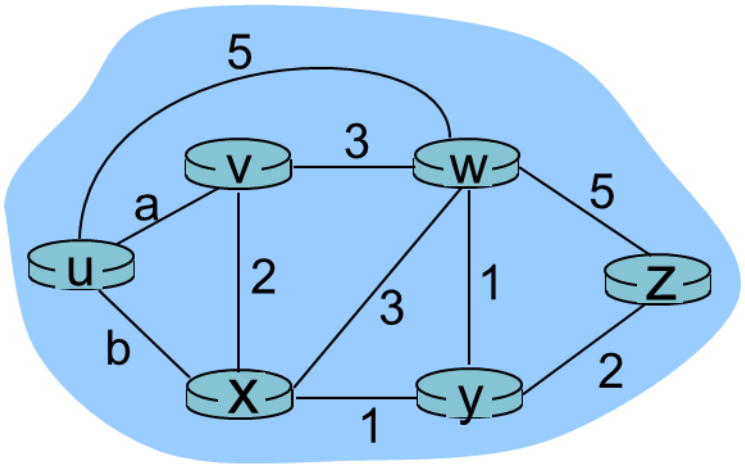

Fig. Q1

Let u be the source node, z be the destination node. Use the Dijkstra's Algorithm to find the shortest paths from u to the rest of the nodes.

a takes the value of the last digit of your student ID.
b takes the value of the second last digit of your student ID.
If any of these values is 0, then take the value of 1.
As an example, for student ID 1171303263, a = 3 and b = 6.

Define clearly all the symbols that you use in your solution.	[4 marks]
Explain your solution clearly step-by-step.	[18 marks]
At the end of your solution, sketch the shortest-path tree.	[3 marks]

Write down your name and student ID in your solution.
Upload your solution. Acceptable file formats are txt, doc, pdf, jpg.
Make sure your solution is clearly readable.

Question 2

You are working for a project of building the communication network infrastructure that provides internet access to a residential area. You are tasked with writing the project proposal. In the proposal, identify a suitable internet access technology and elaborate on it. The proposal aims to convince the decision makers (top management) that the chosen technology is appropriate. The decision makers on the other hand assess your project proposal based on the following criteria:

(i) The **availability and usability** of the chosen technology - Is the chosen technology cheap but too old, or is it new but too expensive?

[2 marks]

(ii) The **economic viability** of the proposal - Has the cost of implementation been weighed? Is it bearable?

[2 marks]

(iii) The **practicality** of the proposal - Is it feasible and implementable, or purely imagined?

[3 marks]

(iv) The **technical details** provided in the proposal - Have the essential technical details been shared, or some irrelevant and unimportant data have been presented instead?

[5 marks]

(v) The **example and sketch** of how the communication network infrastructure covers the service area.

[5 marks]

(vi) The **thoroughness of consideration** - Have the pros and cons of other competing technologies been weighed?

[5 marks]

(vii) The **language and words** used in the proposal - Are they appropriate for the targeted readers (decision makers)?

[3 marks]

You must type your answer in a text file or Word file [except the sketch in part (v)] to facilitate the similarity check. Write down your name and student ID.
Upload your answer. Acceptable file formats are limited to txt, doc, or pdf.
For the sketch in part (v), image file formats and pdf are acceptable.

Question 3

(a) Consider a Carrier Sense Multiple Access/Collision Detection (CSMA/CD) network that transmit data at a rate of 100 Mbps over a 1 km regulated cable without repeaters. Two stations, A and B, with a minimum frame size of 1 kB (kilo-byte) are connected in this network. Station A starts sending a frame at time t = 0 μs and station B starts sending a frame at t = 46.0 μs. Signal is propagation at a velocity of 2×10^7 ms^{-1} in the cable.

(i) Explain the meaning of "regulated cable" in the above network. [2 marks]

(ii) List TWO (2) type of cables that are suitable to be used in the above network. [2 marks]

(iii) Calculate the frame transmission time for both stations. [2 marks]

(iv) Calculate the propagation delay in the network. Assume that all delays in the devices are included and the time needed to send a jamming signal is ignored. [2 marks]

(v) Determine the required transmit period of each station in order to detect collision in the network. [2 marks]

(vi) Estimate when the first bits of the two frames will collide. [2 marks]

(vii) Can station A detect the collision? Explain your answer. [2 marks]

(viii) Can station B detect the collision? Explain your answer. [2 marks]

(ix) Can the above stations transmit in a wireless medium? Explain your answer. [2 marks]

(b) (i) Explain briefly TWO (2) features of Wireless Fidelity (WiFi) 6 or IEEE802.11ax that enable wide range of coverage. [4 marks]

(ii) For high energy efficient home automation Internet of Things (IoT) system, which one is better connectivity to connect multiple battery powered sensors: Bluetooth or WiFi or Zigbee. Explain your answer. [3 marks]

Question 4

A downlink Frequency Division Duplexing (FDD) frame structure based on Orthogonal Frequency Division Multiple Access (OFDMA) for a typical cellular communication system with its respective physical resource block (RB) and resource element (RE) is shown in Figure Q4. The allocated channel bandwidth is 20 MHz. The length of the frame (with 10 subframe) is 10 ms and the width of the resource block is 180 kHz in one time slot. There are 12 subcarriers per resource block used in the channels.

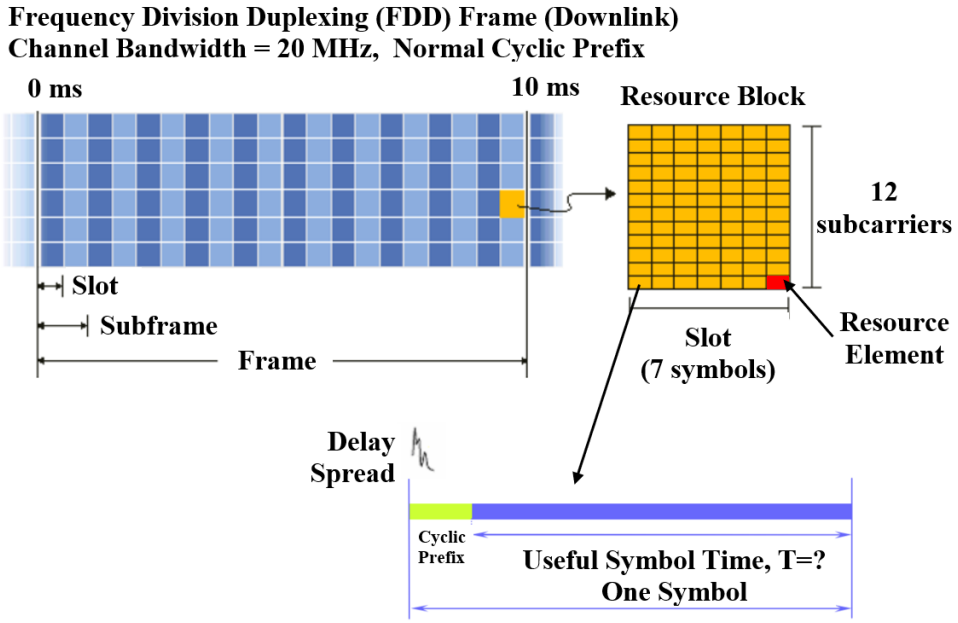

Figure Q4

(i) Which generation of cellular communication system uses the above frame structure? [1 mark]

(ii) State THREE (3) advantages and TWO (2) disadvantages of using FDD in cellular communication. [5 marks]

(iii) State THREE (3) advantages and TWO (2) disadvantages of using OFDMA in cellular communication. [5 marks]

(iv) What is a Resource Block (RB)? [1 mark]

(v) What is a Resource Element (RE)? [1 mark]

(vi) List FOUR (4) others channel bandwidth that are used in the above system. [2 marks]

(vii) Calculate the occupied bandwidth (OBW) if 10% of the channel bandwidth is used as guard bands. [1 mark]

(viii) Determine the time period of a slot and a subframe [2 marks]

(ix) Determine the symbol rate used in this system. [1 mark]

(x) Determine the Useful Symbol Time, if the length of the cyclic prefix is 4.7 μs.

[2 marks]

(xi) Determine the amount of RBs in the above frame. [1 mark]

(xii) What is the frequency spacing of each subcarrier in one time slot?

[1 mark]

(xiii) Determine the total occupied subcarriers (including the DC subcarrier).

[2 marks]